#18/Priority Papers
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Docket No.: M4065.0394/P394
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Neo C. Peng

Application No.: 09/805,111 Confirmation No.: 1491

Filed: March 14, 2001 Art Unit: 3724

For: IN-PROCESS TAPE BUR MONITORING Examiner: B. D. Ashley

SUBMISSION OF PRIORITY DOCUMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Applicant hereby submits a certified copy of the priority document. The Claim for Priority was made in the Declaration filed on May 23, 2001.

Dated: February 11, 2004

Respectfully submitted,

By _____
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REGISTRY OF PATENTS
SINGAPORE

This is to certify that the annexed is a true copy of application as filed for the following Singapore patent application.

Date of Filing	:	19 DECEMBER 2000
Application Number	:	200007526-7
Applicant(s) / Proprietor(s) of Patent	:	MICRON TECHNOLOGY, INC.
Title of Invention	:	IN-PROCESS TAPE BUR MONITORING

SHARMAINE WU (Ms)
Assistant Registrar
for REGISTRAR OF PATENTS

PATENTS FORM 1

Rule 19

SINGAPORE PATENTS ACT (CHAPTER 221) PATENTS RULES

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19 DEC 2000

The Registrar of Patents
Registry of Patents

REQUEST FOR THE GRANT OF A PATENT

THE GRANT OF A PATENT IS REQUESTED BY THE UNDERSIGNED ON THE BASIS OF THE PRESENT APPLICATION

I. Title of Invention	**IN-PROCESS TAPE BUR MONITIRING**	
II. Applicant(s) *(See note 2)*	***(a) Name***	Neo Chee Peng
	Body Description/ Residency	A Singapore Citizen
	Street Name & Number	Blk 582 Ang Mo Kio Avenue 3, #09-3165
	City	
	State	
	Country	Singapore
	(b) Name	
	Body Description/ Residency	
	Street Name & Number	
	City	
	State	
	Country	
	(c) Name	
	Body Description/ Residency	
	Street Name & Number	
	City	
	State	
	Country	

2000075 26 - 7
19 DEC 2000

III. Declaration of Priority (see note 3)	*Country/Country Designated*		*File no.*	
	Filing Date			
	Country/Country Designated		*File no.*	
	Filing Date			
	Country/Country Designated		*File no.*	
	Filing Date			

IV. Inventors (See note 4) *(a) The applicant(s) is/are the sole/joint inventor(s).*	[ ] *Yes* [x] *Yes*	[x] *No* [ ] *No*
(b) A statement on Patents Form 8 is/will be furnished.		

V. Name of Agent (if any) (See note 5)	**DONALDSON & BURKINSHAW**			
VI. Address for Service (See note 6)	*Block/Hse No*	N.A.	*Level No*	N.A.
	Unit No/PO Box	**3667**	*Postal Code*	**905667**
	Street Name	N.A.		
	Building Name	N.A.		
VII. Claiming an earlier filing date under section 20(3), 26(6) or 47(4). (See note 7)	*Application No*			
	Filing Date			

[Please tick in the relevant space provided]:

(√) Proceeding under rule 27(1)(*a*).
Date on which the earlier application was amended =_____
Or
( ) Proceeding under rule 27(1)(*b*).

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VIII. Invention has been displayed at an International Exhibition (See note 8)	*Yes* [ ] *No* [X]
IX. Section 114 requirements (See note 9)	The invention relates to and/or used a micro-organism deposited for the purposes of disclosure in accordance with section 114 with a depository authority under the Budapest Treaty. [ ] *Yes* [X] *No*

X. Check List

(To be filled in by applicant or agent)

A. The application contains the following number of sheet(s):-

1. Request	4	*sheets*
2. Description	8	*sheets*
3. Claim(s).	4	*sheets*
4. Drawing(s).	7	*sheets*
5. Abstract.	1	*sheets*

B. The application as filed is accompanied by:-

1. Priority document	
2. Translation of priority document	
3. Statement of Inventorship & right to grant	X
4. International Exhibition Certificate	

X1. Signature(s)

(See note 10)

Applicant (a)	Donaldson & Burkinshaw for and on behalf of Neo Chee Peng
Date	18 December 2000
Applicant (b)	
Date	
Applicant (c)	
Date	

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19 DEC 2000

NOTES:

1. This form when completed, should be brought or sent to the Registry of Patents together with the prescribed fee and 3 copies of the description of the invention, and of any drawings.
2. Enter the name and address of each applicant in the spaces provided at paragraph II. Names of individuals should be indicated in full and the surname or family name should be underlined. The names of all partners in a firm must be given in full. The place of residence of each individual should also be furnished in the space provided. Bodies corporate should be designated by their corporate name and country of incorporation and, where appropriate, the state of incorporation within that country should be entered where provided. Where more than 3 applicants are to be named, the names and address of the fourth and any further applicants should be given on a separate sheet attached to this form together with the signature of each of these further applicants.
3. The declaration of priority at paragraph III should state the date of the previous filing, the country in which it was made, and indicate the file number, if available. Where the application relied upon in an International Application or a regional patent application e.g. European patent application, one of the countries designated in that application [being one falling under the Patents (Convention Countries) Order] should be identified and the name of that country should be entered in the space provided.
4. Where the applicant or applicants is/are the sole inventor or the joint inventors, paragraph IV should be completed by marking the 'YES' Box in the declaration (a) and the 'NO' Box in the alternative statement (b). Where this is not the case, the 'NO' Box in declaration (a) should be marked and a statement will be required to be filed on Patents Form 8.
5. If the applicant has appointed an agent to act on his behalf, the agent's name should be indicated in the spaces available at paragraph V.
6. An address for service in Singapore to which all documents may be sent must be stated at paragraph VI. It is recommended that a telephone number be provided if an agent is not appointed.
7. When an application is made by virtue of section 20(3), 26(6) or 47(4), the appropriate section should be identified at paragraph VII and the number of the earlier application or any patent granted thereon identified. Applicants proceeding under section 26(6) should identify which provision in rule 27 they are proceeding under. If the applicants are proceeding under rule 27(1)(*a*), they should also indicate the date on which the earlier application was amended.
8. Where the applicant wishes an earlier disclosure of the invention by him at an International Exhibition to be disregarded in accordance with section 14(4)(c), then the 'YES' Box at paragraph VIII should be marked. Otherwise the 'NO' Box should be marked.
9. Where in disclosing the invention the application refers to one or more micro-organisms deposited with a depository authority under the Budapest Treaty, then the 'YES' Box at paragraph IX should be marked. Otherwise the 'NO' Box should be marked.
10. Attention is drawn to rules 90 and 105 of the Patent Rules. Where there are more than 3 applicants, see also Note 2 above.
11. Applicants resident in Singapore are reminded that if the Registry of Patents considers that an application contains information the publication of which might be prejudicial to the defence of Singapore or the safety of the public, it may prohibit or restrict its publication or communication. Any person resident in Singapore and wishing to apply for patent protection in other countries must first obtain permission from the Singapore Registry of Patents unless they have already applied for a patent for the same invention in Singapore. In the latter case, no application should be made overseas until at least 2 months after the application has been filed in Singapore.

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Application Filing Date: / /
Request received on : / /
Fee received on : / /
Amount :
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**Delete whichever is inapplicable*

IN-PROCESS TAPE BUR MONITORING

FIELD OF THE INVENTION

The present invention relates generally to backgrinding semiconductor wafers, and more particularly to preventing excess tape bur from damaging the wafer during backgrinding.

BACKGROUND OF THE INVENTION

An exemplary semiconductor wafer 100 is shown in Fig. 1A. The wafer 100 is formed by slicing a thin circular disk from a purified block of silicon. The wafer 100 may have a thickness ranging from 500 to 1000 microns. A typical wafer 100 may have a thickness of approximately 740 microns. An integrated circuit fabrication process may be used to form a plurality of semiconductor dies 101 upon the wafer 100. Fig. 1B is a cross sectional view of the wafer 100 and shows that the dies 101 are located near the front surface 103 of the wafer. After the dies 101 have been formed, a sawing process is typically used to separate the dies 101 from the wafer 100. Since the dies 101 are separated portions of the wafer 100, the dies 101 have the same thickness as the wafer 100 (e.g., 740 microns).

Each die 101 may be mounted within a package 150 to form a semiconductor chip 200, as shown in Fig. 2. The package 150, which is designed to protect the die 101 and to coupled a plurality of leads 125 to the die 101, is only compatible with dies 101

having a specified range of thickness. For example, a commercial die package may be designed to accommodate dies having a thickness of approximately 305 microns. It is often desirable to reduce the thickness of the semiconductor package. One method of reducing the thickness of a package is to use a thinner package, which often requires the use of thinner dies 101. For example, some packages may only be compatible with significantly thinner (e.g., 100 micron thick) dies 101. Thus, both conventional and thin profile packages often require dies 101 which are much thinner than most wafers 100.

The procedure to reduce the thickness of the dies 101 so that they are compatible with a given package design is known as backgrinding. This procedure takes advantage of the fact that the dies 101 are formed near the front surface 103 of the wafer. Thus, the back surface 104 of the wafer may be ground down to reduce the thickness of the wafer 100, and the dies 101 formed thereon, if the mechanical stress associated with backgrinding can be controlled to avoid fracturing the wafer 100 or damaging the dies 101. Fig. 3 is a block diagram of a backgrinder 402, which includes a chucktable 300 and grinding wheel 310. The chucktable 300 is used to flatly support the wafer 100 as it is backgrinded by the grinding wheel 310. The flat support offered by the chucktable 300 distributes stress induced by the grinding wheel 310, thereby reducing the chance of wafer fracture. Additionally, referring also to Fig. 5, a layer of protective tape 320 is attached to the front surface 103 of the wafer 100 by a tape applicator 400. Thus, the layer of protective tape 320 lies between the front surface 103 of the wafer 100 and the chucktable 300, thereby protecting the dies 101 and further absorbing mechanical stress.

However, as illustrated by Fig. 4, when excess tape 325 extends significantly beyond the perimeter of the wafer 100, that excess tape 325, also known as tape bur 325, may become trapped and folded between the chucktable 300 and the wafer 100. The tape bur 325 can prevent the chucktable 300 from flatly supporting the wafer 100, and increase the possibility of uneven back side grinding and possible wafer fracture.

In order to minimize this problem, the wafers 100 are processed by a tape cutter 401 before they are backgrinded. The tape cutter 401 is responsible for trimming the protective tape 320 at or near the perimeter of the wafer 100, thereby removing any tape bur 325. However, the tape cutter 401 cannot consistently guarantee that each processed wafer 100 is free of tape bur 325 because the tape cutter 401 is susceptible to several malfunctions. Thus, under certain circumstances, a tape cutter 401 may output a wafer 100 with tape bur 325 for subsequent processing by the backgrinder 402. Accordingly, there is a need for an apparatus and a method to prevent a tape cutter from outputting a wafer with tape bur for subsequent processing by a backgrinder.

SUMMARY OF THE INVENTION

The present invention is directed at a method and apparatus for preventing wafer breakage, caused the presence of a tape bur, during a wafer thinning process. In the present invention, a sensor is added to the tape cutting unit. The sensor enables the tape cutting unit to detect whether the protective tape has been properly trimmed. If the sensor concludes that the protective tape has not been properly trimmed, the tape cutter unit can take corrective action to prevent a wafer having the improperly trimmed tape from being

processed by the backgrinder. For example, the sensor can trigger a circuit which halts the tape cutter. Alternatively, the circuit can cause the tape cutter to route the improperly trimmed wafer to an alternate area, where it can be examined by a technician or reprocessed.

BRIEF DESCRIPTION OF THE DRAWINGS

The forgoing and other advantages and features of the invention will be more clearly understood from the following detailed description of the invention which is provided in connection with the accompanying drawings.

FIG. 1A is a top view of a semiconductor wafer containing a plurality of dies;

FIG. 1B is a cross sectional view of the semiconductor wafer illustrated in FIG 1A;

FIG. 2 illustrates a semiconductor die and package;

FIG. 3 illustrates a backgrinder containing a wafer having a layer of protective tape attached to its front surface supported by a backgrinder chucktable;

FIG. 4 illustrates how tape bur can prevent the chucktable of a backgrinder from flatly supporting a wafer;

FIG. 5 is a block diagram of a system used for backgrinding;

FIGS. 6A and 6B are illustrations of a portion of a prior art tape cutting unit; and

FIGS. 7A and 7B are illustrations of a portion of a tape cutting unit in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Now referring to the drawings, where like reference numerals designate like elements, there is shown in Fig. 5 a block diagram of a system for backgrinding wafers. A wafer 100 is processed by a tape applicator 400, which attaches a protective tape 320 to the front surface 103 of the wafer 100. Excess tape surrounding the wafer, known as tape bur 325, is trimmed at or near the perimeter of the wafer 100 by a tape cutter 401. The wafer 100 is subsequently processed by the backgrinder 402, which grinds the back surface 104 of the wafer 100 until the wafer 100 has been ground down to the desired thickness. Although Fig. 5 illustrates the tape applicator 400, the tape cutter 401, and the backgrinder 402 as separate devices, it should be appreciated these devices 400-402 may be partially or fully integrated into a lesser number of devices. For example, the tape applicator 400 may be combined with the tape cutter 401, or the tape cutter 401 may be integrated with the backgrinder 402.

Fig. 6A and 6B are more detailed diagrams of a prior art tape cutter 401. Fig. 6A is a top view while Fig. 6B is a side view. The tape cutter 401 accepts a wafer 100 including a layer of protective tape 320 applied to the front surface 103 of the wafer 100.

The tape cutter 401 includes a cutting element 410 and an overload sensor 412. The cutting element may be any tool capable of cutting the protective tape 320. For example, the cutting element 410 could be a heater blade. The cutting element 410 is positioned at or a predetermined short distance beyond the perimeter of the wafer 100 and may be rotated about the wafer 100 in order to remove tape bur 325. Alternatively, the cutting element 410 may be stationary while the wafer 100 is rotated. The overload sensor 412 measures the stress encountered by the cutting element 410 and is designed to shut off or otherwise disengage the cutting element 410 if unusual stress is encountered. After the wafer 100 has been processed by the tape cutter 410, the wafer 100 is made available to the backgrinder 402.

Unfortunately, the tape cutter 401 is incapable of consistently supplying wafers 100 to the backgrinder 402 which are free of tape bur 325. A wafer 100 which has been processed by the tape cutter 401 may have tape bur 325 due to a several reasons. For example, the cutting element 410 may malfunction and fail to cut the tape 320. Alternatively, the cutting element 410 may not be aligned properly and might not cut the tape 320 at the proper location. Unusual stress may have been measured by the overload sensor 412 thereby causing the cutting element to be turned off or disengaged. Since the tape cutter 401 always outputs its processed wafers 100 to the backgrinder 402, there is a possibility that a wafer 100 with tape bur 325 may be given to the backgrinder 402.

The tape cutter 401' according to the present invention is shown in Fig. 7A (top view) and 7B (side view). The tape cutter 401' is similar to the prior art tape cutter 401, but includes a sensor 420 which is coupled to a circuit 430. In the exemplary

embodiment, the sensor 420 is a mechanical sensor which is placed behind the cutting element 410 relative to the direction A of cutting at a predetermined short distance (e.g., 0.5 mm) from the perimeter of the wafer 100. The short distance is chosen based on how much tape can protrude from the perimeter of the wafer 100 without increasing the risk of improper wafer backgrinding due to a tape bur. Thus, the sensor 420 may be placed at varying distances from the perimeter based upon, for example, the thickness or the stiffness of the protective tape 320. Alternatively, the sensor 420 may be any other type of sensor capable of differentiating between the presence and absence of the protective tape. For example, the sensor could be an optical sensor.

The sensor 420, which is coupled to a circuit 430 and which is provided behind the cutting element 410 relative to the direction A of cutting, is used to determine whether the cutting element 410 properly and completely removed the tape bur 325 during a tape cutting operation. If the sensor 420 detects a tape bur 325 after the cutting operation, the circuit 430 causes the tape cutter 401' to take corrective action. The corrective action can be any action which prevents the wafer 100 with tape bur 325 from being processed by the backgrinder 402. In the exemplary embodiment, the circuit 430 halts the tape cutter 401' and prevents automated movement of the wafer 100 to the backgrinder 402. Alternatively, the tape cutter 401' could be triggered by sensor 420 and associated circuit 430 to route improperly trimmed wafers 100 to an alternate location (e.g., a reprocessing area). It is also possible to stop operation of the backgrinder 402 by a signal from circuit 430 when the backgrinder 402 receives a wafer containing a tape bur 325.

While certain embodiments of the invention have been described and illustrated above, the invention is not limited to these specific embodiments as numerous modifications, changes and substitutions of equivalent elements can be made without departing from the spirit and scope of the invention. Accordingly, the scope of the present invention is not to be considered as limited by the specifics of the particular structures which have been described and illustrated, but is only limited by the scope of the appended claims.

What is claimed as new and desired to be protected by Letters Patent of the United States is:

1. An cutting apparatus for removing a portion of a protective tape from a wafer, comprising:

a support for holding a wafer having a protective tape thereon;

a cutting element placed at a first predetermined distance from said support for moving relative to said support to cut protective tape from a wafer placed on the support;

a sensor for detecting if protective tape on a wafer is properly removed by said cutting element; and

a circuit for initiating corrective action when the sensor detects that a protective tape is not properly removed from a wafer by said cutting element.

2. The apparatus of claim 1, wherein the circuit for initiating corrective action stops operation of said cutting apparatus.

3. The apparatus of claim 1, wherein the circuit for initiating corrective action prevents a wafer on said support from being moved to a grinding area.

4. The apparatus of claim 1, wherein the circuit for initiating corrective action prevents a backgrinding apparatus from grinding the wafer.

5. The apparatus of claim 1, wherein the sensor is an mechanical sensor.

6. The apparatus of claim 1, wherein the sensor is an optical sensor.

7. The apparatus of claim 1, wherein said first predetermined distance is approximately 0.5 mm from the edge of a wafer placed on said support.

8. The apparatus of claim 1, wherein the sensor is placed behind the cutting element in a direction of cutting action of said cutting element.

9. A method for removing a portion of a protective tape from a semiconductor wafer comprising:

cutting the protective tape at a predetermined distance from the perimeter of the wafer;

sensing whether said cutting has properly removed the protective tape; and

taking a corrective action if said protective tape has not been properly removed.

10. The method of claim 9, wherein the step of sensing further comprises sensing whether said protective tape exists at said predetermined distance from the perimeter of the wafer.

11. The method of claim 9, wherein the corrective action is halting further cutting operation.

12. The method of claim 9, wherein the corrective action is preventing the wafer from being subsequently backgrinded.

13. The method of claim 9, wherein the step of sensing is a mechanical sensing.

14. The method of claim 9, wherein the step of sensing is an optical sensing.

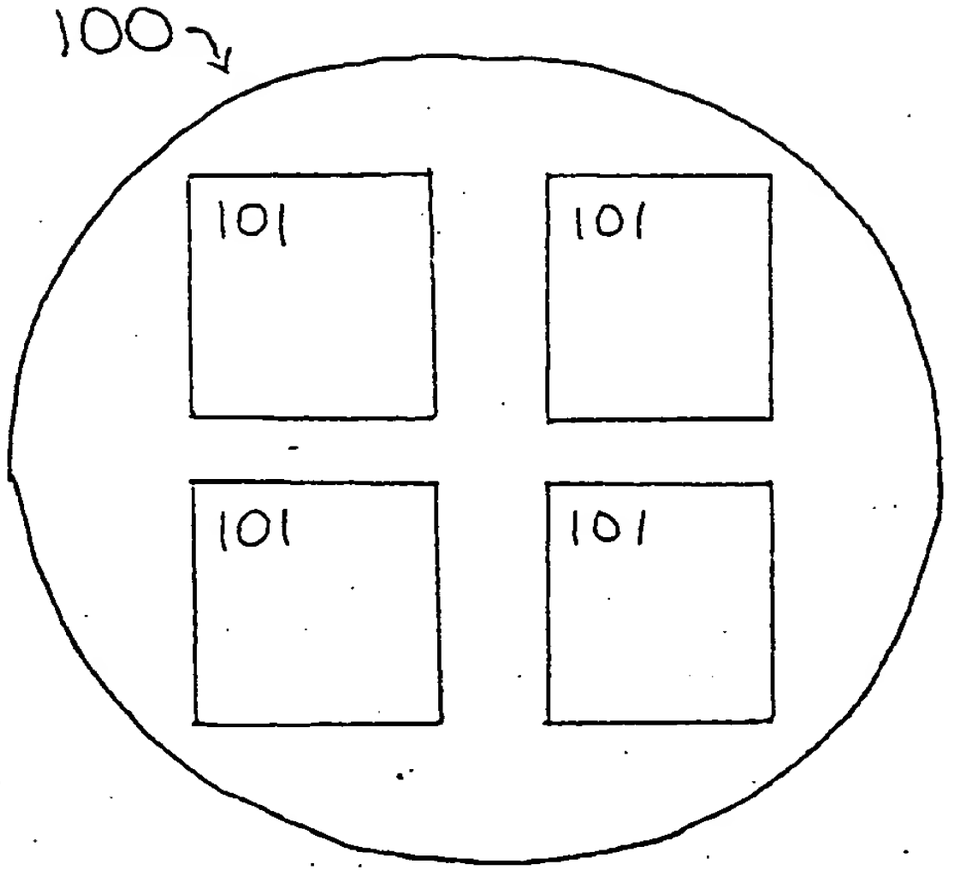
15. The method of claim 9, wherein said predetermined short distance is approximately 0.5 mm.

ABSTRACT

IN-PROCESS TAPE BUR MONITORING

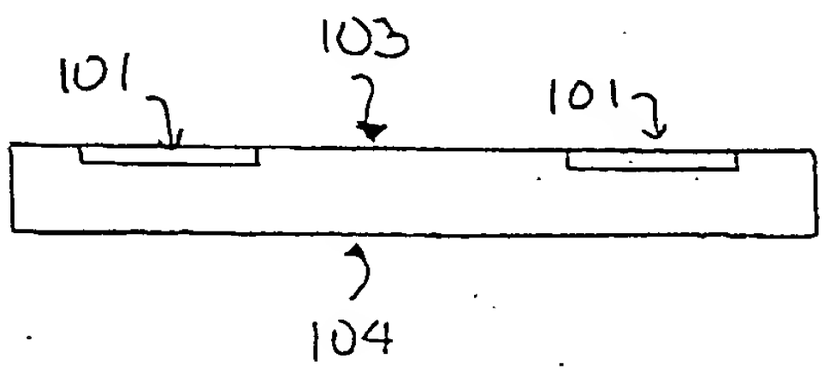
The protective tape applied to the front surface of a semiconductor wafer to protect the wafer during backgrinding must be trimmed so that excess tape, known as tape bur, does not extend beyond the perimeter of the wafer. Tape bur may interfere with backgrinding by causing improper grinding, which may lead to wafer breakage. The tape cutter that trims the protective tape to eliminate tape bur is provided with a sensor which detects whether tape bur has been trimmed from the wafer. If tape bur has not been removed from the wafer, corrective action is taken to prevent the wafer from being backgrinded.

FIG. 1A



PRIOR ART

FIG 1B



PRIOR ART

FIG. 2

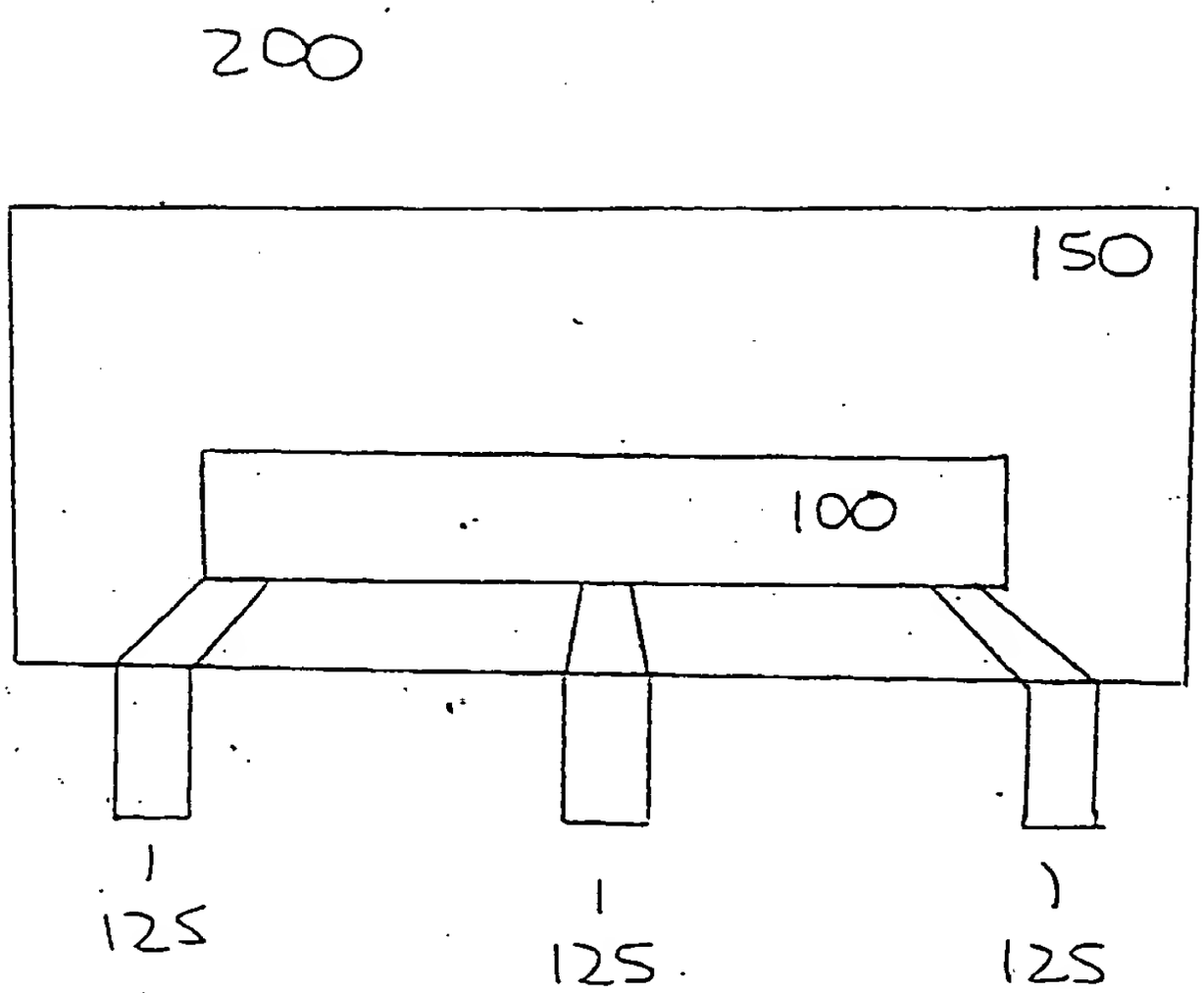
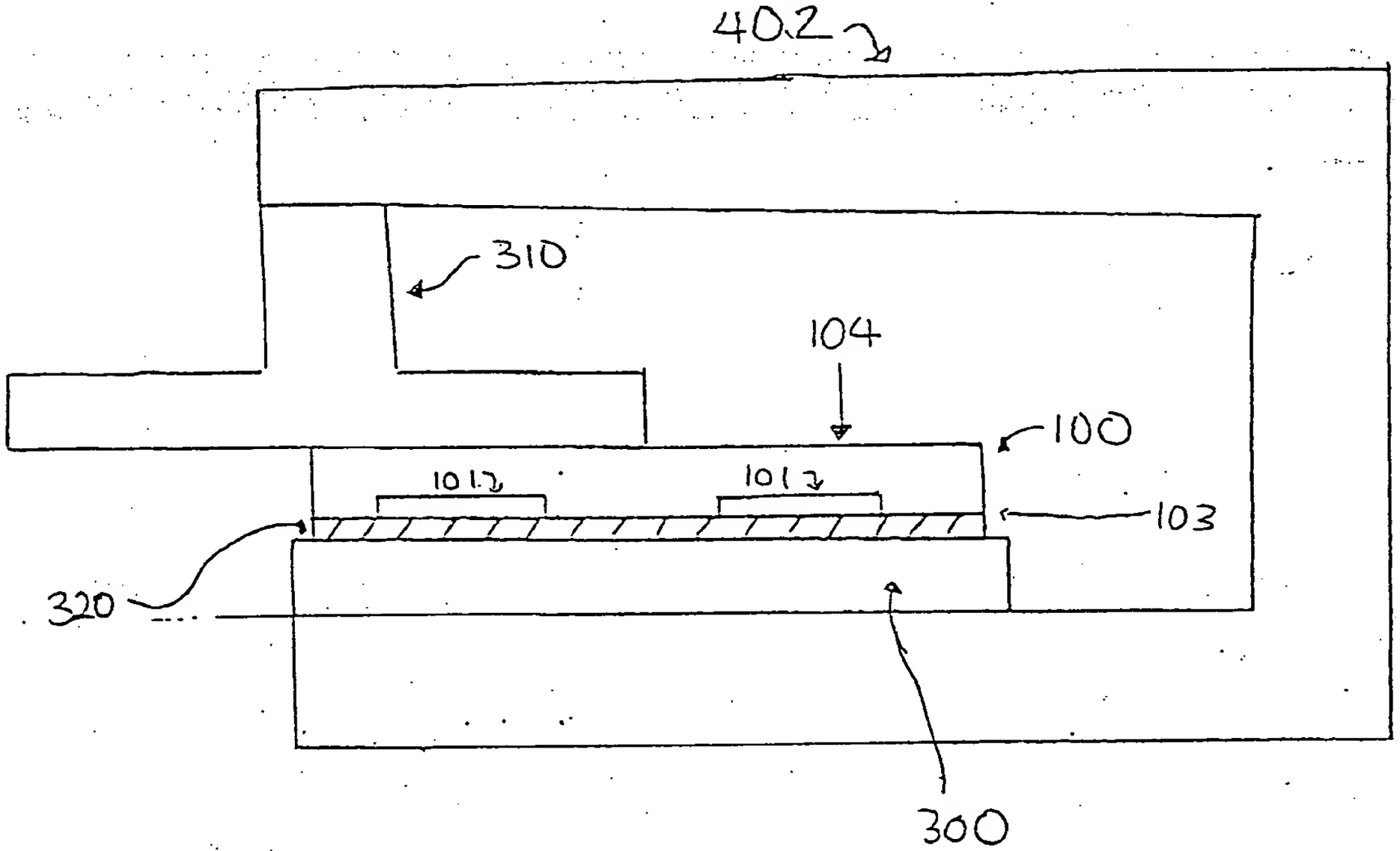
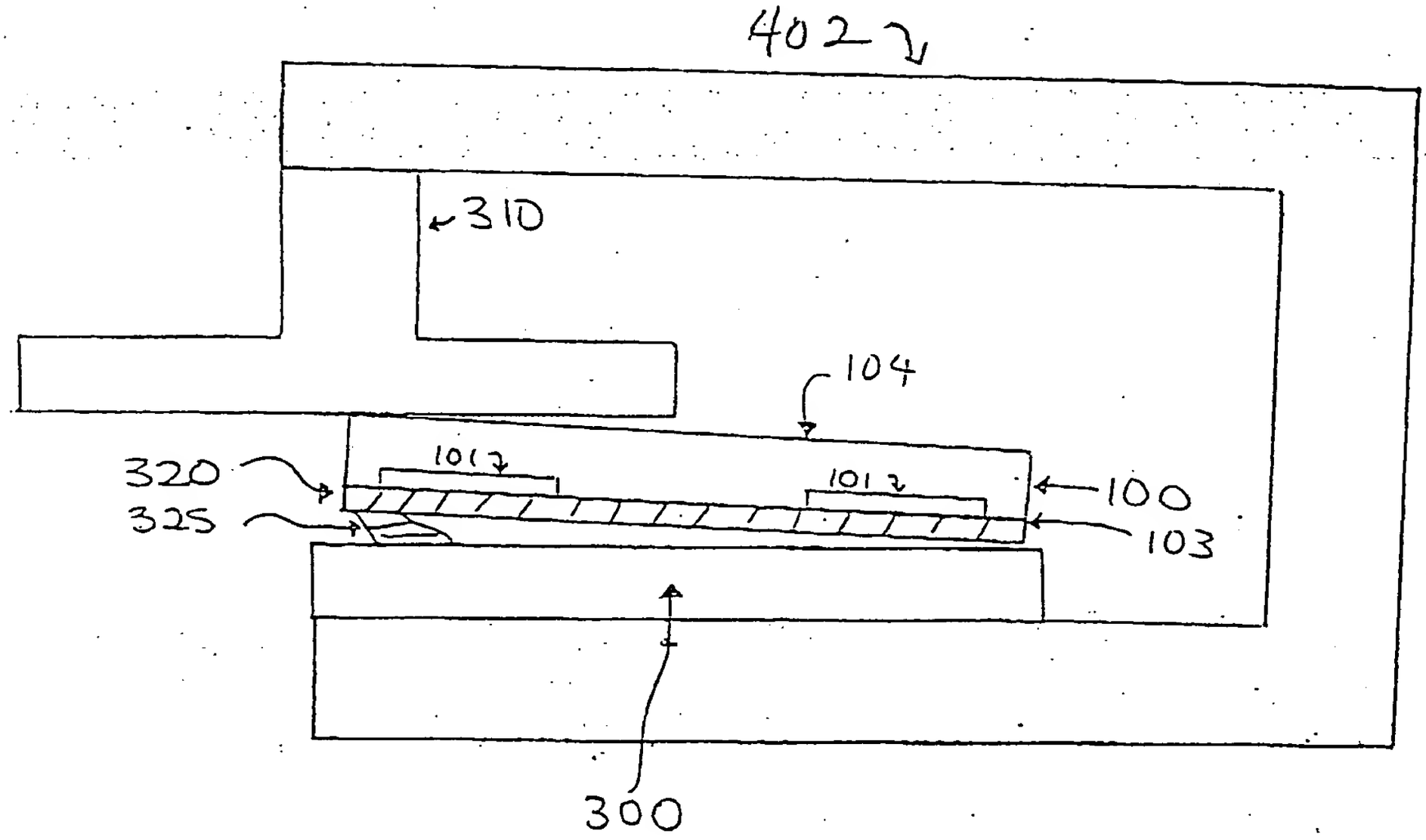


FIG. 3



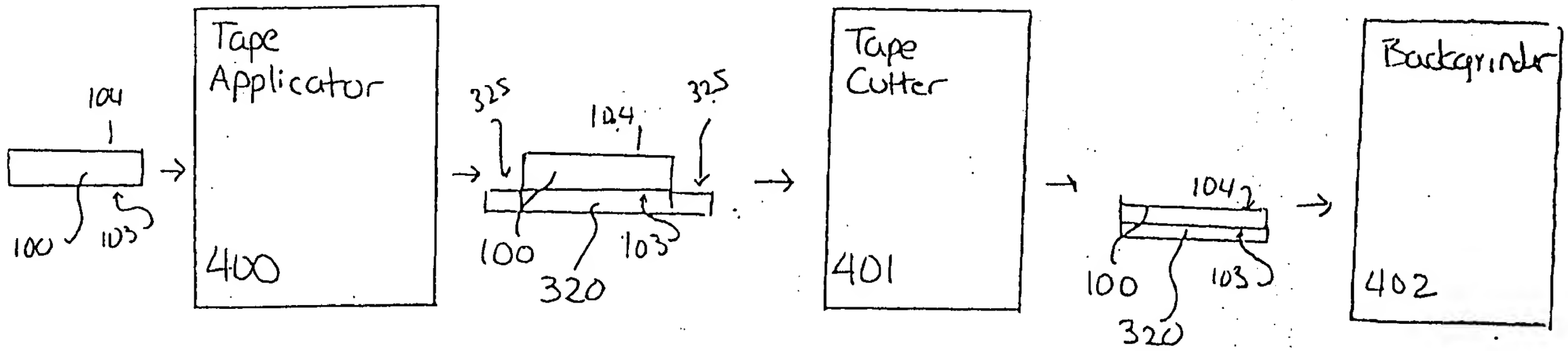
PRIOR ART

FIG. 4



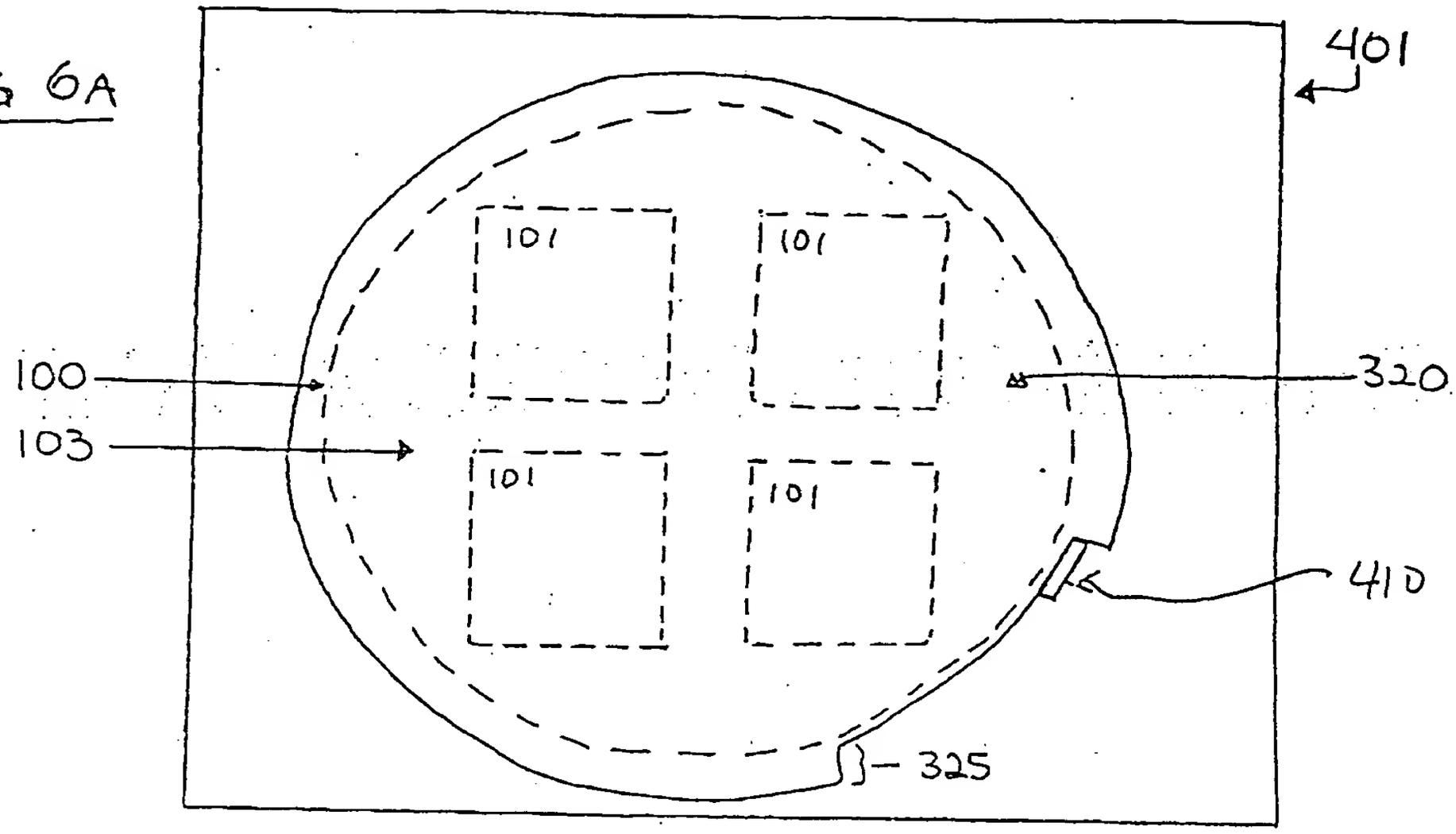
PRIOR ART

FIG 5



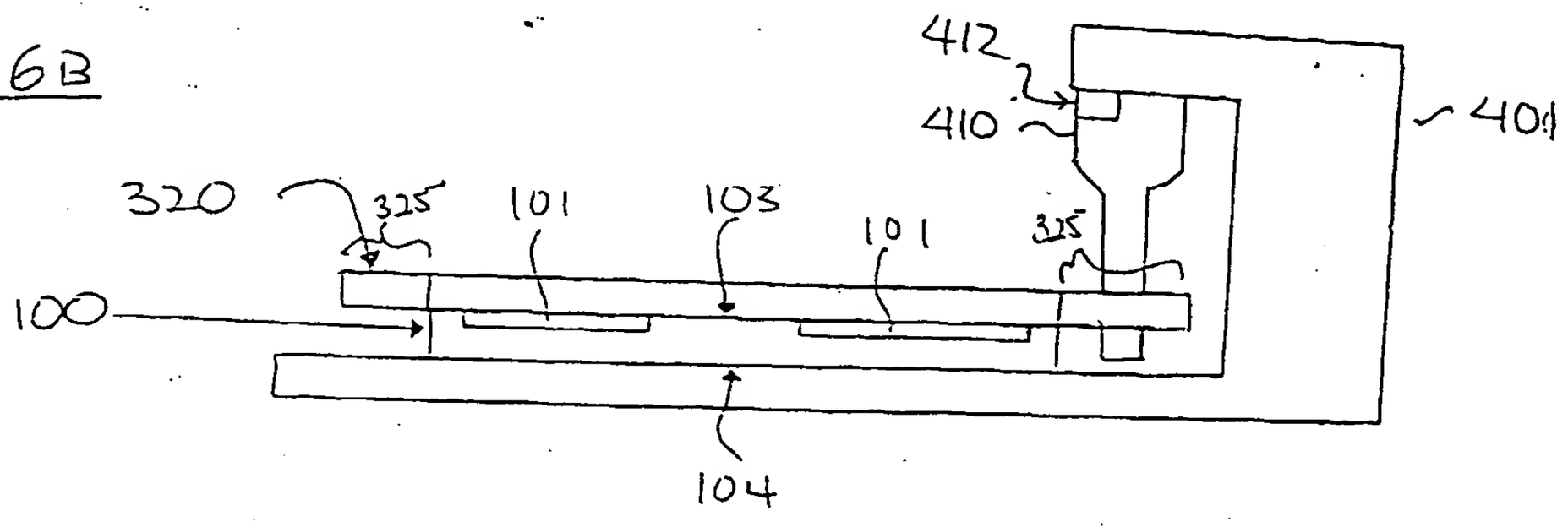
PRIOR ART

FIG 6A



PRIOR ART

FIG 6B



PRIOR ART

FIG 7A

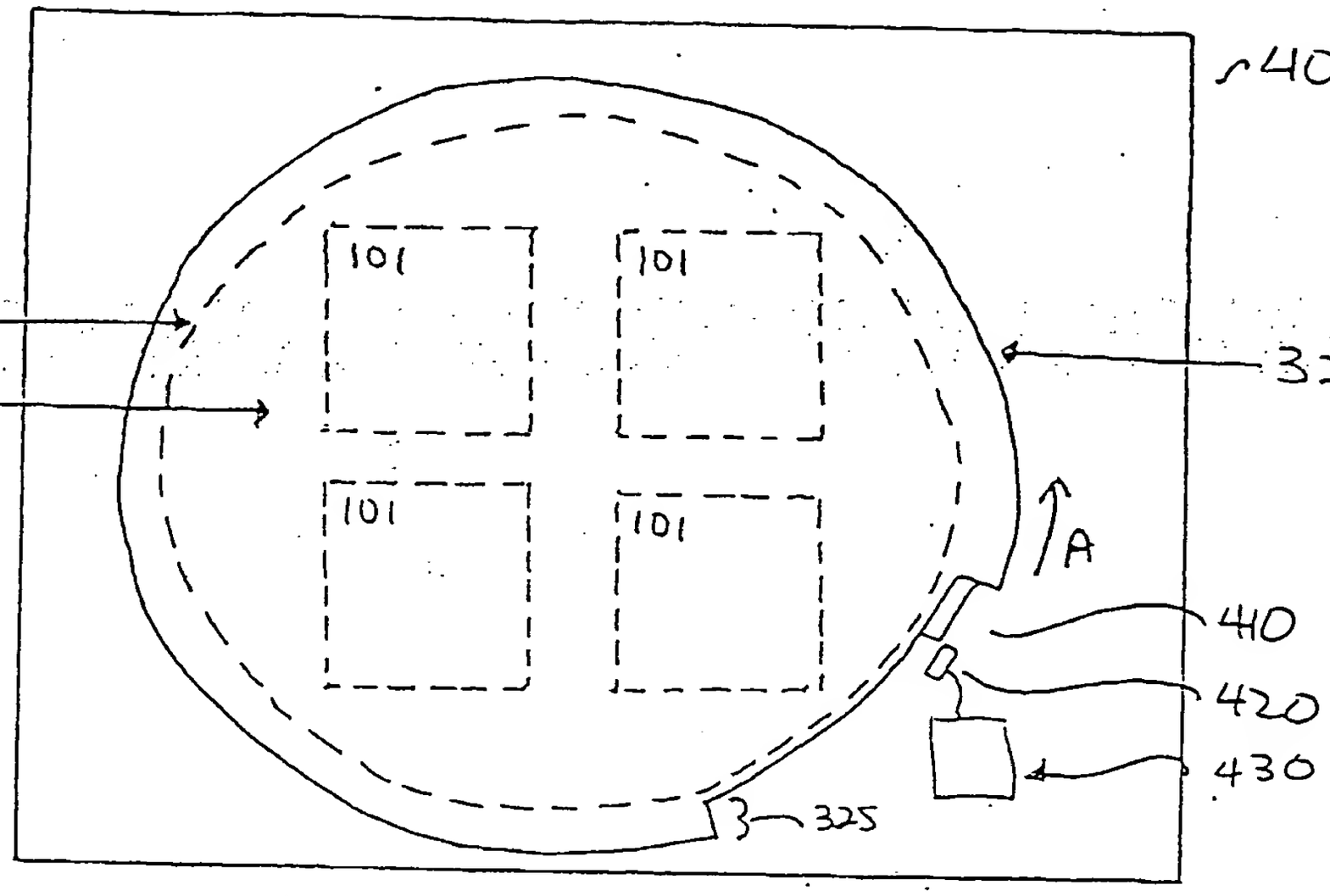


FIG 7B